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and defended especially by the Pythagoreans. Unfortunately Aristotle, not satisfied with the dogmatism of that school, arrayed himself against the doctrine, and long afterwards was followed by Ptolemy in the *Almagest*; and so the science of Astronomy was retarded for a millennium. Copernicus was familiar with all these facts. There are extant ancient works, maintaining the correct doctrine, with marginal notes made by Copernicus. Even the precession of the equinoxes was discovered by the ancients and estimated with great precision. The *cause*, of course, remained a mystery until Newton discovered the general nature of gravity. (The cause, gravity, still remains a mystery. We call it "gravitation", and sometimes we hear of the "attraction of gravitation", which Newton never called it).

Most of the facts stated above are familiar, some of them, in fact, being found in our elementary text-books of astronomy, but the chief object of this paper is to call attention to two almost universally ignored contributions of the ancient Greeks to the science of Mathematics. One of the most difficult subjects to treat adequately is the history of mathematics. Cantor's treatment of the mathematics of the Greeks is wholly inadequate, and I have had occasion elsewhere to call attention to one of his errors. The "specialist" selected to treat this subject for Müller's *Handbuch* says that for some unknown reason H instead of E was used to denote 100 in the old system, when the initial letter denoted numerals. In other words, this specialist did not know that in the fifth century B. C., H was the aspirate at Athens. He is a *mathematical* specialist, and no one can censure him. To treat this subject requires the collaboration of a mathematician and a Hellenist; and it is proper that I should explain why I venture to touch upon it. When I went to Germany I was in doubt whether to make the Classics my specialty, or Mathematics, for which as a college student I had a special fondness. So I conceived the idea of combining the two and writing my dissertation on the Greek mathematicians. After some months of research, it became evident that what I had in mind would require a large volume and years of labor, including a study of Arabic. In the meantime I had been surprised to find some things in the Greek mathematicians that are almost universally supposed to be modern. Since that time there has appeared a work just such as I had the ambition to write: *Die Lehre von den Kegelschnitten im Alterthume*, by Professor Zeuthen of the University of Copenhagen, translated from the Danish and published in German in 1886. If anyone is inclined to question the correctness of the statements I am about to make, let him first study Archimedes and Apollonius of Perge in the original

and then the analysis contained in the work of Zeuthen.

The two most important steps in the progress of modern mathematics were the introduction of coordinate axes and of the infinitesimal calculus. To take these up in inverse order, I cannot go as far as Zeuthen and assert that Archimedes was familiar with and applied the integration of a differential equation (of course, expressed geometrically); but I do not hesitate to say that some of his processes, translated into modern notation, would be the integration of differential equations. This fact is specially notable in his method of finding the area of an ellipse and of a segment of a parabola. The process would suggest the invention of the (algebraic) calculus to very few minds, but it might well suggest it to a Newton or a Leibnitz. I have called the attention of mathematicians to this fact; but the reply usually is that, in finding the area of a parabola segment, he summed an infinite converging series, but that this is not integration. Of course it is not; but he found the area in two ways, and it is the other way to which I refer. A statement of it here would be entirely out of place.

As to coordinate axes the case is different. Descartes did not invent coordinate axes. They were familiar to him from the work of Apollonius of Perge on Conic Sections. The great contribution of Descartes, whereby he founded modern mathematics, was simply showing how by algebra we could perform the operations which Apollonius performed by what is called "geometrical algebra". With this assertion I must let the matter rest. I once called the attention of a mathematician, who had written a considerable series of mathematics, to the fact just stated, and, admitting that the ancients were familiar with projection, he utterly denied that they knew anything about coordinates.

By these allusions to mathematicians it is not in the least intended to reflect on mathematicians in general nor to imply that all or most of them are ignorant of the facts stated, but to produce a justification for this paper, intended as it is for teachers of the Classics. M. W. HUMPHREYS

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AENEID V

In a recent number of *THE CLASSICAL WEEKLY* (27) the statement was made that interest in the Aeneid lagged in the fifth book, and that other teachers are of the same opinion is shown by the fact that in some schools this book is omitted.

My experience, however, with successive classes of girls is, that not only interest may be aroused and attention held, but even enthusiasm often evoked. Indeed, the interest shown in the whole story seems wonderfully cumulative, reaching its

climax in the sixth book, where the greatest questions of human life and destiny are grappled with, and Vergil's noble nature is most clearly revealed, while opportunity is given for the first brief introduction of the class to Plato and Dante, linking their conceptions with the already familiar ones of Milton. And nothing could be better fitted to prepare the minds of students to turn from Dido's hopes and fears, her making and breaking of resolutions, her bitter reproaches and passionate despair, to the eschatology that is woven into the warp and woof of our fathers' theology and colors our own visions of the future, than this episode of the games.

The healthy-minded modern athletic girl, though too ready to judge Aeneas by the standards she would apply to a man in her own set, becomes a bit weary of the folly of the heroine of fiery southern blood, a Cleopatra, and takes a deep breath of fresh air when Aeneas *certus* is out on the broad sea again.

Aeneas's way of expressing devotion to a father's memory finds present day parallels, and there is as careful consideration of the prizes as if they were the cups and medals now awarded. After the naming of boats and captains, but before the race really begins, that is, has been assigned for a lesson, each girl is asked to write and lay on the desk the boat she favors. From that moment we are present on shore or deck. The names of boat, captain, and *favorites* have been written on the board for quick reference and that the memory may not be taxed with non-essentials, the course is also drawn, and when the relative position of the boats changes, this is indicated on the course. The impetuous Gyas, pushing the helmsman from the rudder as a Roosevelt might do, rouses a heartier laugh than the sorry plight of old Menoetes while he tries to climb the rock of safety, which so appealed to the Trojans' sense of humor, and Mnestheus's noble exhortation, coupled with the fine spirit of the true sportsman, rouses a thrill of pride in those who chose his name. It is more than a far off echo of races at Poughkeepsie and New London that we enjoy with these bronzed veterans of the sea.

The foot race, too, is vivid and full of color. Aeneas's justice to an alien people and his great kindness are emphasized by putting on the board the nationality of each of the contestants with his name. Three Trojans, one of them a royal prince, are in line with two in whose veins courses the blood of their foes, and with these dart forward two Sicilians. It is no tame and decorous race, but one in which the unexpected happens, and human nature is seen at its worst and its best. In such scenes, by sharing in the work of preparation, by his sympathy and sense of humor, by his readiness in every emergency, Aeneas shows that he is leader of men by native gifts.

At first thought, it might seem better for girls to

leave the scene when men put on the gloves, and it is well for the teacher himself to read a few of the lines that depict brutality with most vividness, passing over them lightly as may be, and yet in this contest between athletes, any girl is glad to have the braggart defeated, and to have the old champion, who roused himself because his chieftain exhorted him to fight for the honor of the tribe, win, and prove his mighty prowess by the death of a beast rather than a man.

When the pugilists are warding off blows or flying before them, the reading is interrupted a moment, and each girl is asked to write what she thinks the women are doing while the men watch the sports. These notes are read just before the pathetic incidents of the burning of the ships are assigned for a later lesson, and the class begins that passage with curiosity whetted, eager to learn whether the women have been getting dinner, applauding with the men, or engaged in prayer, for these are the three commonest guesses. The interest never flags throughout the book, for in the archery contest the mysterious burning of the arrow arouses expectation, and Iulus in his cry to the distracted women *En, ego, vester Ascanius* is like Prince Charles with the Highland maids and matrons. In these episodes, woman's part in the old Roman world is revealed and the simple sincerity of the Roman faith in the Divine, two topics that crowd the brief time possible in class for discussion.

The more one studies this fifth book, the more does Vergil's consummate skill in his art become clear and the satisfaction grows that he has put this vivid, wholesome picture of the strenuous life of play between the rapture and pain of the winter at Carthage and the prophetic visions and spiritual insight beyond the Styx. LAURA B. COLLIER

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REVIEW

The Greatness and Decline of Rome. Volume III (The Fall of an Aristocracy), pp. 342; Volume IV (Rome and Egypt), pp. 291. By Guglielmo Ferrero. Translated by H. J. Chaytor. New York: G. P. Putnam's Sons (1908). \$2.50 per Volume.

Volume III extends from 44 to 37 and Volume IV continues the narrative to 23 B. C., so that thus far the work, apart from the introductory chapters, covers a period of a little more than fifty years. If it continues, as projected, to the fall of the empire in equal detail, we may expect the completed history to contain more than forty volumes. Mere bulk is not in itself a merit; in fact it is far easier for a historian to use all his material than to exclude the relatively unimportant matter. These two volumes, for instance, contain many military and personal details which are unessential to an under-